INVENTIONS & INNOVATION

Project Fact Sheet

Lightweight and Cost-Effective Cast Aluminum Diesel Engine Head with Localized Reinforcement

Reducing the weight of a light truck's diesel engine head will increase vehicle fuel economy

Benefits

- Offers savings of 117 trillion Btu by 2010
- Light truck fuel economy would increase by 50% with use of these new diesel engine heads

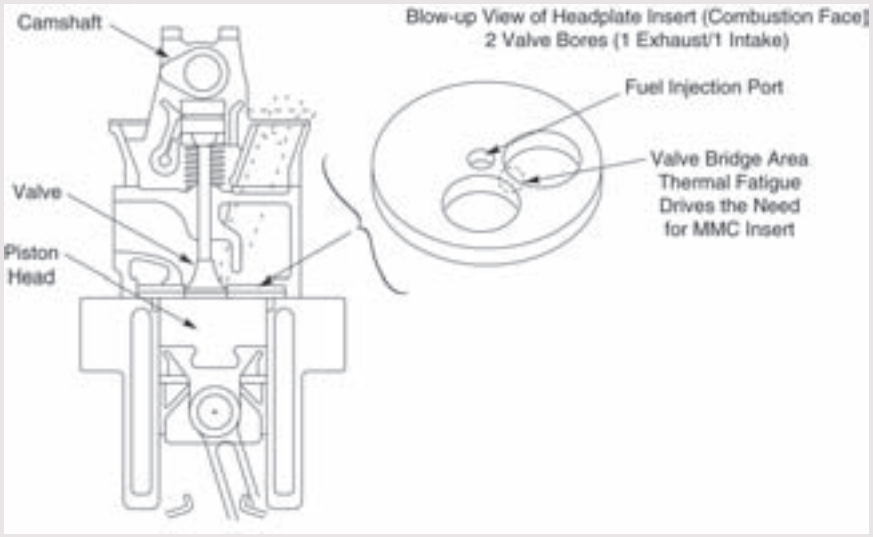
Applications

Light trucks (pick-ups, vans, and sport utility vehicles) are the primary users of this technology. A secondary use of this technology process would be to replace certain cast iron, steel, or titanium castings with aluminum castings using MMC inserts to reduce weight and decrease cost.

Light trucks (pick-ups, vans and sports utility vehicles) currently account for about 30% of all transportation energy use. Successful development and insertion of suitable diesel engines to replace gasoline engines in light trucks would produce an over 50% improvement in fuel economy, and would lower the national transportation energy use by over 15% with a comparable reduction in emissions. The challenge is to produce diesel engines with performance and weight comparable to that of current gasoline engines. Specifically, to reduce the engine weight to the level specified for light trucks, the block and head will need to be made out of aluminum (rather than the current cast iron). The problem is that the aluminum castings do not have adequate mechanical properties to withstand the high loads and temperatures in certain regions of the engine block and head.

Foster-Miller's approach to overcome this problem is to locally reinforce the highly loaded regions in aluminum gravity castings with metal matrix composite (MMC) materials. Foster-Miller has already optimized a proprietary MMC material and demonstrated locally reinforced aluminum gravity castings at the subcomponent level. This project will produce and test a full-scale medium-duty aluminum diesel engine head casting.

Cast Aluminum Diesel Engine Head with Localized Reinforcement



Aluminum diesel engines require localized reinforcement in regions such as valve bridge areas of the engine head.

Project Description

Goal: To prove the viability of producing aluminum gravity cast diesel engine head (and block) components with localized MMC reinforcing inserts in the combustion plate area. The technology will be refined at the subcomponent level, and then fabrication and testing of full-scale engine head castings will be done.

To meet the overall goal, the project will: demonstrate MMC insert design and configuration and the ability to withstand the fabrication and service loads; demonstrate casting tooling and technology that gives structurally effective incorporation of the MMC insert within the head gravity casting; and show sufficient performance, durability and affordability of the technology for diesel engine applications.

Progress and Milestones

The following are the main tasks to be performed:

- Model and design MMC inserts and then procure inserts in sufficient quantity for the remainder of the project.
- Fabricate representative head subcomponents with MMC combustion plate reinforcement inserts and test the subcomponents to select the optimized insert geometry and gravity casting parameters for full-scale head fabrication.
- Build two full-scale prototype diesel engine heads with the MMC inserts and subject the head components to a battery of tests.

Economics and Commercial Potential

Foster-Miller is working with a project team that includes a major engine manufacturer and castings producer. The technology would thus be well positioned for implementation in commercial diesel engines. Commercial introduction of the technology is expected by 2006. Annual energy savings by 2010 would be 117 trillion Btu. By 2020 the savings would grow to 1490 trillion Btu.

The Inventions and Innovation Program works with inventors of energy-related technologies to establish technical performance and to conduct early development. Ideas that have significant energy-savings impact and market potential are chosen for financial assistance through a competitive solicitation process. Technical guidance and commercialization support are also extended to successful applicants.

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